

Dry Evergreen Forest of Point Calimere and Marakanam¹

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(With three plates)

The "tropical dry evergreen forests" have been distinguished by several authors, notably by Champion (1936); they represent a peculiar type that is confined to Northern Ceylon and to the coastal regions of Coromandel.

In Ceylon, this group comprises dense formations that constitute true forests. In India, these formations are essentially thickets, more or less dense, well characterised in the littoral reserved forests of the Bay of Bengal, notably in Point Calimere and Marakanam. For the latter region there exist some publications concerning forestry and ecology (Krishnan 1940; Dabholkar 1962; Legris 1963; Krishnan 1971) or history and zoology (Daniel 1967), but no detailed study on ecology, physiognomy or dynamism seems to have been done so far in these regions. Therefore, our investigations deal with these points essentially.

ECOLOGY

Four principal ecological factors should be considered: rainfall, duration of dry seasons, seasonal variations of temperature and finally, physical properties of soils.

The temperature varies very slightly from locality to locality and from season to season at these latitudes of 10° to 12° North. During the least hot month, January, the mean temperature is of the order of 24°C with absolute minimum 17°C and absolute maximum 30°C. During the hottest months, May and June, the average is 31.5°C, the absolute maximum of the order of 40°C and the absolute minimum rarely under 25°C.

1—*Rainfall, dry seasons and relative humidity*

The average annual rainfall in the region of Vedharanyam—Naga-

¹ Accepted April 26, 1972.

pattinam is about 1300 mm i.e. practically of the same order as in the Marakanam-Pondicherry region.

The distribution of rainfall in the course of the year (Plate II, figs. 1 and 2) brings out well-marked maxima in October, November or December whereas the summer is dry or sub-dry according to the years. Compared to the normal tropical rainfall regime with maxima in July and August of the west coast of southern India, there is a shift of the high rains towards the end of the year. The first consequence of this regime is prolongation of the average dry season up to June. Thus the climates of the east coast of S. India manifest a long *average dry season* of at least six months duration from January to June.

Another fundamental characteristic of these climates is the large variability of rains from year to year. Even the months appearing as the most humid on basis of averages may be totally dry in certain years. The number of rainy days during the months of October and November varies from 2 to 21.

There are years with high rainfall but containing a very long dry season; this is the case of 1969 during which was recorded 1743 mm at Nagapattinam but 9 consecutive months were dry (Plate II, fig. 3). Some other years like 1970 have an attenuated and discontinuous dry season (Plate II, fig. 4).

Another essential character of the rainfall is the violence of precipitation. The usual number of rainy days per year is 55 to 70 mm but often amounts exceeding 100 mm are recorded in a day. Some recent examples are given below:

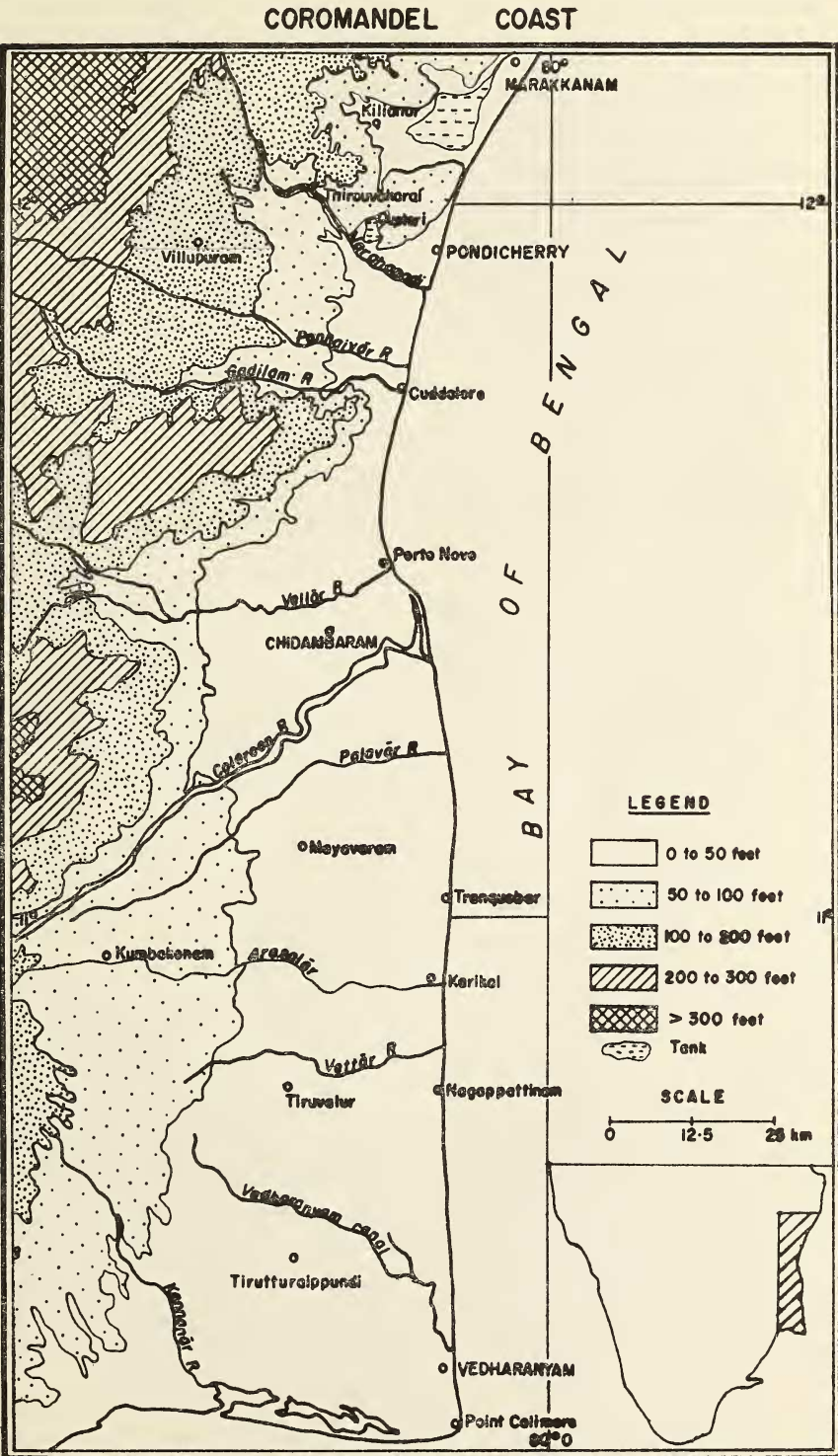
Nagapattinam — 1969 :	19 Nov.	20 Nov.	16 Dec.	27 Dec.	30 Dec.
	155 mm	100 mm	108 mm	133 mm	127 mm
Pondicherry — 1969 :	20 Oct.	23 Oct.	19 Nov.	20 Nov.	9-10 March, 1971
	165 mm	150 mm	209 mm	201 mm	242 mm

There are even more serious cases of excessively rainy cyclones precipitating more than 1000 mm in 3-4 days. This was the case in Pondicherry in May, 1943 (1097 mm).

The high amount of rains are almost always of cyclonic origin. In three years (1968 to 1970) we have counted 13 cyclonic depressions and 7 cyclones that affected these coastal areas from September to December.

Detailed examination of meteorological data shows that in a normal rainfall year, on the eastern coast of S. India, 70 to 95 per cent of the rains from September to December and 40 to 70 per cent of the annual rainfall are due to the cyclones.

This uneven distribution of rain has two disadvantages: a strong erosive force of the precipitation causing considerable damage to the terrain, and a low efficiency for the vegetation. It is evident that 200



OMBROTHERMIC - DIAGRAMS

Fig. 1

NAGAPPATTINAM (mean data)

Longitude : $79^{\circ} 51'$ Latitude : $10^{\circ} 14'$

Altitude : 9m

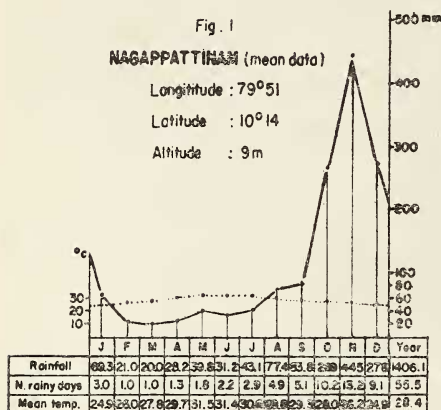


Fig. 2

PONDICHERRY (mean data)

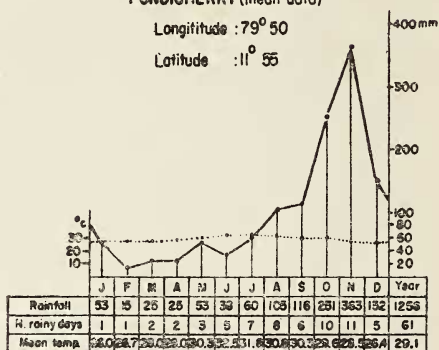
Longitude : $79^{\circ} 50'$ Latitude : $11^{\circ} 55'$ 

Fig. 3

NAGAPPATTINAM

Year 1969

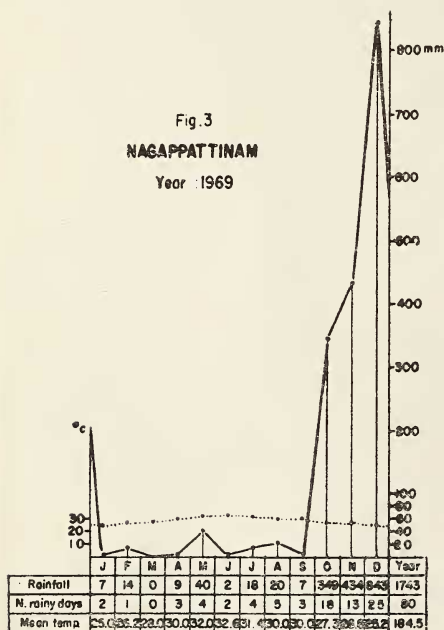
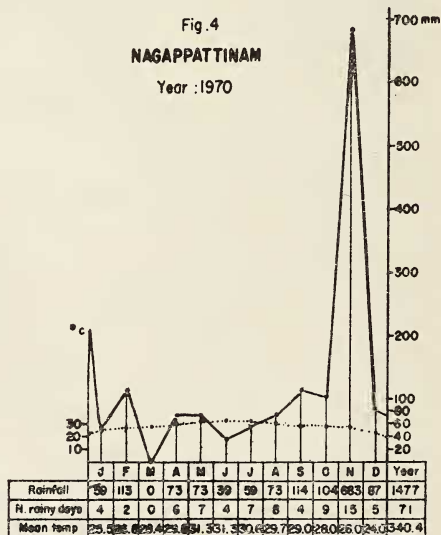


Fig. 4

NAGAPPATTINAM

Year : 1970



mm rainfall in some hours has not the same effect on the vegetation as 200 mm in 10 days.

In these regions near the ocean, the *relative humidity* does not remain high throughout the year. The continuous records maintained at the French Institute may give some precision.

From October to March-April, its values vary between 70 and 90 per cent. On the rare rainy days the values remain practically constant between 90 and 95 per cent; on the days without rains, one observes a classical rhythm of maximum at day-break (6 to 8 a.m.) and minimum between 1 to 3 p.m.

The relative humidity is minimum in June and July when the winds are blowing over the dry land. The variations are between 50 and 70 per cent with minimum of the order of 40 per cent in the beginning of the afternoon. At this time of the year, the mean monthly deficit of saturation reaches high values of the order of 15 mm. This factor may explain certain xeromorphic structures.

Remarks

The rainfall regimes of these coastal regions of Coromandel resemble to a certain extent those of the mediterranean climate with autumn and winter rains, the summer being dry but there the comparison ends because the day-length, thermic amplitudes and the absolute minima of temperature differ completely. The tropical climates with dissymetric rainfall regime raise the problems of classification and one may question whether the distribution of the rains in the year is an important or minor factor at these latitudes where the thermic amplitude is relatively low.

The physiognomy of the vegetation types much resembles the mediterranean maquis and amongst the species which may be cultivated figure the Carob-tree (*Ceratonia siliqua*) and the olive (*Olea europaea*). The trial of acclimatization of mediterranean species covers only 4 years but we may say that their vegetative growth has so far progressed normally under the climate of Pondicherry.

2—Physical properties of Soils

It does not seem that there exists a very distinct edaphic unity on the littoral. At Point Calimere, the thickets develop on the dunes and alluvia; at Marakanam on a relatively light colluvium, rich in quartzite; at Ousteri and Thirouvakarai on ferruginous sandstone. Elsewhere the rock of the coastal hillocks is a type of Charnockite, hardly altered at the surface. Some precisions are given below.

"Alluvial soils and Regosols" on sand dunes of Point Calimere

Included in the Caverry delta, this coastal region is essentially formed of fluvial alluvia and dunes. The "dry evergreen" thickets grow on these types of soils.

In the coastal plains having a very slight slope, the recent deposits, essentially of fluvial origin, are called the *alluvial soils*.

The pedologic horizons are not distinct there having no clear cut separation between the horizons. The only well individualised horizon is at the surface of greyish colour in a humid state. It contains a little of organic matter. This A1 horizon is usually clayey sand, with pebbles, gravels or concretions. The average depth is 30 to 40 cm; it contains the majority of roots and rootlets. A1 may be dry in summer (May to July) but it may be covered with a thin layer of brackish water during the strong tides of September and October.

Below 40 cm, the layers are permanently humid, richer in clay but poorer in organic matter. Below the depth of 60 cm begins to appear a pale grey layer very rich in clay which is penetrated only by some big roots. Here the water-table persists even in the dry season.

As a rule these soils are halomorphic with a muddy structure in moistened state and a compact structure in dry state. The saline efflorescence is often formed at the surface due to the capillary rise of salts (mainly Sodium chloride). Their formation is favoured because of the proximity of the sea and the length of the dry season. This fact explains the presence of halophytes in the dry evergreen thickets and in the discontinuous grasslands they contain.

The "regosols" on the sand dunes at Point Calimere

Their morphology is extremely simple; the dune is composed of fine sand, yellowish white in colour. It bears a single vegetation type: evergreen thicket, more or less dense, without halophytes. A small quantity of superficial organic matter appears under the woody elements. Wherever the plant-cover is interrupted, the barren sand is exposed. These soils are consolidated only under the thicket stage; elsewhere they are continuously altered by the eolian erosion.

The "lithosols" on ferruginous colluvium of Marakanam

They have probably originated from the Cuddalore sandstone through erosion. This has caused a general loosening of the soil with apparent bed formations resulting in the accumulation of quartz pebbles alternating with layers less encumbered with coarse material. The fine material has generally disappeared at the surface, removed by the violent run-off three months per year.

The "lithosols" on colluvium or on Cuddalore sandstone have several characteristics in common:

- Their richness in quartz is such that all the farming implements are rapidly worn out.
- Only the top 20 cm of soil is of value from agricultural point of view. Below this level, the clay layers are more or less indurated. The management technique should therefore try to limit the working of the soil to the thin surface layer by scratching, superficial at the beginning, going deeper each year.
- These terrains are excessively poor in organic matter and very dry if deprived of the vegetation. A cover of trees, even scattered, is sufficient enough to change radically the properties of the upper horizon by increasing organic matter and moisture content.

SOME FLORISTIC PECULIARITIES

Thanks to the publications of Sebastine (1967) on Vedharanyam (Point Calimere) and Marlange & Meher-Homji (1965) on the Pondicherry-Marakanam region, precise botanical information is available but this is not yet complete. Here is a list of the common woody plants that we collected from Vedharanyam, not cited by Sebastine (l.c.): *Maba buxifolia*, *Ehretia microphylla*, *Ehretia aspera*, *Carissa spinarum*, *Canthium parviflorum*, *Pterolobium indicum*, *Erythroxylon monogynum*, *Maytenus emarginata*, *Atalantia monophylla*, *Pleurostyliya opposita*, *Murraya exotica*, *Breynia rhamnoides*. A common species like *Capparis zeylanica* (Daniel 1967, p. 513) is also not mentioned.

Based on the botanical information available till present, we may draw the following main conclusions.

- This part of littoral belongs to the "eastern floristic province, Carnatic sector" (Blasco 1971), in which the number of endemics (about 50) may be considered as low.

- Over the whole of the littoral, the Dicotyledonous species would be about 500 including aquatic, mangrove and terrestrial forms.

- Over a given regional area, the maximum number of the Dicotyledons is 200 to 300. In the Point Calimere Sanctuary covering about 25 square kms of ligneous and herbaceous vegetation, one may collect about 200 species of non-parasitic Dicotyledons.

The following observations may be made from the floristic analysis of the area:

- The more or less radicant herbs form the majority, about 50 per cent of the species.

- The shrubs and undershrubs with nearly 22 per cent of species and the climbers mostly ligneous (17%) occupy second place. Arbo-

rescent vegetation contributes only about 10 per cent of species.

— An important fraction of this flora has a very vast distribution. There are about 42 (21%) pantropical species occurring in all the tropical floristic empires: *Tamarix gallica*, *Abrus precatorius*, *Tephrosia purpurea*, *Vernonia cinerea*, *Achyranthes aspera*, *Ageratum conyzoides* etc. There are also zoochore and anthropochore plants whose dispersal through the agency of animals and man make them ruderals or weeds of cultivated fields; examples are *Desmodium triflorum*, *Evolvulus alsinoides*, *Borreria articularis*, *Boerhaavia diffusa*.

— 40 species (20%) are typically Asian. A large number of species of the warmer parts of Asia is naturally to be expected in these formations: *Carissa spinarum*, *Erythroxylon monogynum*, *Atalantia monophylla*, *Capparis zeylanica*, *Gmelina asiatica*, *Calotropis gigantea*, *Premna serratifolia* etc.

— 36 species (18%) belong to India and Ceylon. Their number is inferior to the pantropical species. This Indo-Ceylon flora comprises fundamental ligneous elements like *Manilkara hexandra*, *Ixora arborea*, *Randia malabarica*, *Cadaba fruticosa*, *Maytenus emarginata*, *Canthium parviflorum* or very common herbs like *Mollugo disticha*, *Blumea obliqua*, *Justicia prostrata* etc.

— 28 species (14%) are Afro-Asian (some of these are Afro-Indian): *Toddalia asiatica*, *Cissus quadrangularis*, *Oldenlandia herbacea*, *Salvadora persica*, *Azima tetraacantha*, *Pleurostylia opposita* etc.

— 14 species (7%) are common to the warm regions of Asia, Australia and Africa: *Maba buxifolia*, *Dichrostachys cinerea*, *Xeromphis spinosa*, *Asystasia gangetica* etc. The species common to Asia and Australia are only about 10 (5%) but some of the ligneous members are very important in these regions: *Zizyphus oenoplia*, *Pongamia pinnata*, *Pavetta indica*.

— The endemics play a minor role. According to our relevés, there are only 7 of which 4 are endemic in the flora of south India (*Ceropegia candelabrum*, *Sarcostemma intermedium*, *Leucas diffusa* and *Jatropha tanjoorensis*), the remaining three are confined to Peninsular India (*Rivea hypocrateriformis*, *Ehretia aspera*, *Pterolobium indicum*). Mention may be made of *Salacia chinensis*, a Hippocrateaceae, very common in these regions but which does not seem to have been recorded in India, south of Visakhapatnam.

— This flora contains nearly 20 introduced or cultivated species which are naturalised (*Phaseolus trilobus*, *Mimulus elengi*, *Catharanthus roseus*, *Prosopis juliflora*, *Ocimum canum* etc.) and a small number of species with exceptional geographic distribution.

— A number of halophilous species occurs in the Vedharanyam region. Certain are characteristic of the saline soils, others withstand a certain amount of salinity: *Salvadora persica*, *Clerodendrum inerme*,

Solanum trilobatum, *Excoecaria agallocha*, *Prosopis juliflora*, *Heliotropium curassavicum*, *Enicostemma hyssopifolium* etc.

— The above results are in general valid for the reserved forest of Marakanam too. However, the halophytes are totally absent in the thickets. A detailed examination reveals further floristic differences. The “dry evergreen thickets” of Marakanam region contain little of *Manilkara hexandra*, on the other hand *Memecylon umbellatum* and *Canthium didymum* are much better represented here. Besides, *Albizzia amara*, *A. lebbek*, *Acacia caesia*, *Pterospermum suberifolium*, *Jasminum* spp., *Gelonium lanceolatum* and especially *Chloroxylon swietenia* are found in Marakanam whereas these have not been noted in Point Calimere.

One may therefore conclude that the flora of the evergreen thickets is essentially formed of species having a vast geographic distribution and consequently a large ecological tolerance; the endemics are not only small in number but are of rare occurrence.

PRINCIPAL VEGETATION TYPES

1) *The dry evergreen thickets of Point Calimere*

At Vedharanyam the ligneous formations are found on clayey alluvium and dunes. In our opinion this is an example of the tallest and the most dense type of “dry evergreen forest” described by Champion (1936) and Champion and Seth (1968) that may be taken up for investigation.

As a matter of fact, even the best formation is stunted, almost exclusively formed of bushes much branched practically up to the soil level and measuring 2 to 4 m in height. Here and there emerge some evergreen arborescent shrubs (*Manilkara hexandra*) under 10 m in height with dark green voluminous crowns.

On the sand dunes are found the formations that we may refer to as “high, thorny, evergreen thickets”. A schematic profile diagram of this formation is given (Plate III).

There is a discontinuous arborescent stratum of *Manilkara hexandra* with some *Canthium dicoccum* that is far less voluminous than *M. hexandra*.

The continuous and principal stratum is thorny with a slight numerical dominance of *Maytenus emarginata*, *Maba buxifolia*, *Randia malabarica*, *Zizyphus oenoplia*. Other non-thorny ligneous species are also very common but their density varies from place to place. This

is the case with *Memecylon umbellatum*, *Murraya exotica*, *Sapindus emarginatus*, *Premna serratifolia*, *Ixora parviflora*, *Pleurostyliia opposita*, *Canthium didymum*. Therefore, in the thicket, the majority of the species are non-thorny though the number of the individual thorny plants appears to be higher than the others. They make the entry into the thicket particularly difficult especially the invading spinescent climbing shrubs like *Toddalia asiatica* var. *gracilis*. Moreover, the number of stems per unit area is very high.

The general impression of thorny thicket is also given by the abundance of *Dichrostachys cinerea*, *Securinega leucopyrus*, *Carissa spinarum*, *Gmelina asiatica*, *Phoenix pusilla*, *Azima tetracantha* bushy elements at the borders of the thickets, covered with spines. They become rare or disappear in the interior of the thicket. At the borders are also found some unarmed species like *Clerodendrum inerme*, *Cassia auriculata*, *Breynia rhamnoides* and spiny climbers like *Solanum trilobatum* and *Asparagus racemosus*. Generally, the lianas grow well even in the interior of the thickets but relatively few species are encountered: *Asystasia gangetica*, *Cissus quadrangularis*, *C. vitiginea*, *Pergularia daemia* that do not extend up to the top of the thicket whereas *Sarcostemma intermedium* (a leafless Asclepiadaceae), *Gloriosa superba* and *Rivea hypocrateriformis* reach the highest branches.

Phanerogamic parasites are rare with the exception of *Cassytha filiformis*. The herbaceous ground cover is excessively poor.

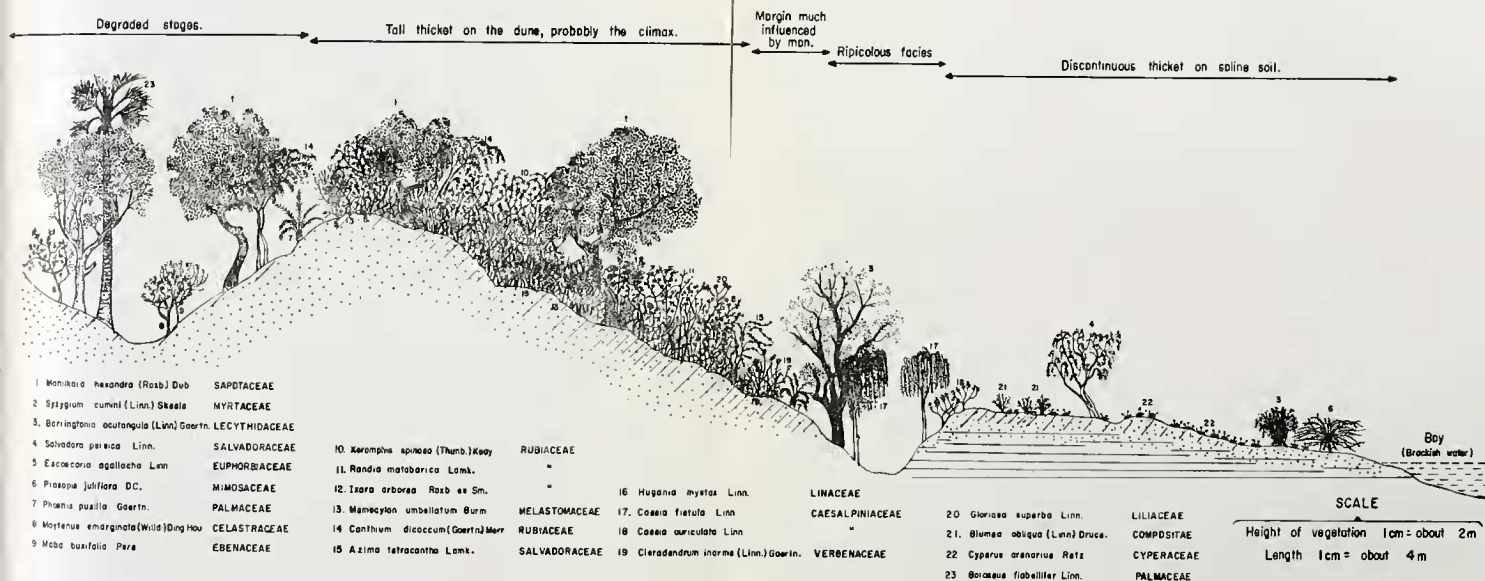
Being accessible, this vegetation is often traversed by man and openings are made in places. Also, some anthropic stages appear here and there with *anthropochore* trees like *Syzygium cumini*, *Borassus flabellifer*, *Lannea coromandelica* and others.

On alluvial halomorphic soils, "the forest is not continuous but intersected by numerous tidal inlets and creeks" (Daniel, l.c., p. 513).

There exist various stages of transitions between the purely sandy dune and the essentially clayey alluvial soils. Amongst the ligneous elements of the dunes there are many that withstand slight salinity and form thickets like those described above. Only *Manilkara hexandra*, the principal tree on the dune disappears totally or nearly on poorly drained, salty terrain. The thicket then presents a more regular appearance, less high, but the natural openings are many wherever there is saline efflorescence. Certain shrubs like *Hugonia mystax*, *Scutia myrtina*, *Salvadora persica* and *Excoecaria agallocha* are very common.

Dynamism. In absence of a detailed study, it is difficult to give precise results on the dynamism of the vegetation in these regions. One thing certain is that the thickets are often invaded by the population to get their requirement of fuel wood. On the dunes, the equilibrium of the woody species is precarious. There are hardly any seedlings of these species observed colonising the cleared areas. As their

PROFILE DIAGRAM OF THE FORMATIONS IN THE LITTORAL REGION OF POINT CALIMERE (VEDHARANYAM).



growth is apparently very slow, special attention should be paid to the protection of the vegetation. It may be added that the herbaceous *Bulbostylis barbata* and *Gisekia pharnaceoides* do not appear to be very efficient in checking the eolian erosion in these regions frequently affected by the cyclones.

Practically all the thorny shrubs of the thickets may be considered as the pioneers. Under their light shade and protection, and due to the thin superficial humus layer they form, seedlings of *Manilkara*, *Drypetes*, *Pleurastylia*, *Canthium* etc. may develop. These shrubs, if not cut, may give rise to the discontinuous dominant stratum of the formation.

On the halomorphic soils of the tidal inlets and creeks, things are different because almost a continuous herbaceous cover precedes the woody species and also because there appear quick growing species like *Prosopis juliflora*, *Salvadora*, *Excoecaria*, *Clerodendrum inerme* capable of forming a bush within 5-6 years. Here is a case of vigorous dynamism, the precise stages of which yet remain to be investigated.

Between the clumps of shrubs develops a low but dense grassy carpet of Cyperaceae (about 10 cms in height) on the halomorphic soils. It is grazed by the cattle and represents a sort of equilibrium between dynamism of shrubs on the one hand and the biotic factors on the other.

This pasture is likely to be immersed under a thin layer of brackish water during the strong tides of October-November. Two Cyperaceae play an essential role—*Fimbristylis spathacea* and *Kyllinga monocephala*; in number they dominate over the other species. Another Cyperaceae—*Cyperus arenarius* may be locally very abundant. Two Graminae are not rare: *Eragrostis riparia* and *Tragus biflorus*.

The remaining flora is essentially comprised of *Phyla nodiflora**, *Portulaca oleracea*, *P. wightiana*, *Leucas diffusa*, *L. aspera*, *Oldenlandia umbellata*, *Evolvulus alsinoides**, *Hybanthus enneaspermum*, *Tribulus terrestris**, *Boerhaavia diffusa**, *Phyllanthus niruri*, *Borreria articularis*.

In these pastures, isolated shrubby elements are not rare. These are almost always *Prosopis juliflora* and some species of the back mangroves like *Excoecaria agallocha*, *Clerodendrum inerme*, *Suaeda maritima* and *Salvadora persica*.

2) The dry evergreen thickets of Marakanam—Physiognomy and flora

The colluvial terrain includes an important proportion of clay between gravel. Therefore these soils are apparently more favourable to the shrubs than the dunes of Vedharanyam as they have larger moisture retentive capacity. However, the abusive and selective exploitation of unarmed shrubs for the production of green manure has

* These are pantropical species.

totally altered the physiognomy and floristic composition of the formation. But away from the roads there remain some vestiges that are only slightly disturbed and that may be considered as quite representative and probably near the climax.

At first view the formation resembles a mediterranean maquis. However, it contains an extraordinary quantity of large shrubs, the girth of stems being 1 to 30 cm, and lianas. Over one square metre one may count up to 10 ligneous species, confusedly intermingled. Therefore, in our opinion, it is not possible to give a correct account of the structure of the formation with a photograph as there is too much of overlapping and lack of clarity.

The overall aspect is that of a dense and continuous thicket of an average height of 2-3 m, from which emerge isolated or in clumps some small trees with thick foliage. The principal cover bristles with thin terminal branches, mostly spiny, hanging like an arch above the thicket.

At the margin, many shrubs belong to complex life-forms, commonly referred to in the English literature as *scrambling*, *straggling* or *climbing shrubs*; it is sometimes difficult to distinguish between these forms. The more common species make the formation impenetrable; amongst these may be cited *Gmelina asiatica*, *Carissa spinarum*, *Caparis stylosa*, *Hugonia mystax*, *Pterolobium indicum*, *Fluggea leucopyrus*, *Cansjera rheedii*, *Acacia caesia*, *Calycopteris floribunda*, *Strychnos colubrina*. These microphyllous, spinescent, light demanders form a spiny, dense rampart around the thicket. They may penetrate deeply in the formation because of the clearings made in the thicket. In the openings are found pioneer species, the most remarkable being *Dodonaea viscosa*, *Cassia auriculata*, *Dichrostachys cinerea*, and some rare succulent species: *Euphorbia antiquorum*, *Caralluma* spp., *Sanseveria roxburghiana* etc.

In less disturbed thicket, the flora changes. Amongst the more common species may be cited *Maba buxifolia*, *Erythroxylon monogynum*, *Ehretia microphylla*, *E. aspera*, *Xeromphis spinosa*, *Atalantia monophylla*, *Premna serratifolia*, *Drypetes sepiaria* but special mention must be made of *Memecylon umbellatum*, *Canthium didymum*, *Ixora parviflora* and *Murraya exotica*. The last mentioned three species sometimes emerge 2 to 3 m above the thicket but sometimes are at the level of the thicket or below it, flowering and fruiting at the stage of dwarf under-shrubs, 50 cm high. These variations in life-forms of a same adult species, in a same formation, baffle phytogeographers and botanists. Two other factors also add to the confusion; these are the extraordinary density of the branches and the convergence of the growth-forms. Most of the species are spiny microphyllous or squamophyllous with thick and dark cuticle.